CHAPTER I

SUMMARY OF TROPICAL CYCLONES OF 1960

A. GENERAL

During 1960, in that area of the Pacific west of 140° W and N of the equator, 56 tropical disturbances were numbered as cyclones. Of this number, 3 had warnings issued as tropical depressions only, 8 had warnings issued as tropical storms, and 19 achieved full typhoon intensity. The term "tropical cyclone" or "cyclone", as used herein, is defined as a suspected tropical cyclonic circulation which appears capable of intensification. A cyclone is assigned a number for purposes of reconnaissance and to assure that records regarding it are not confused with those of another circulation. A tropical depression is a tropical cyclone with a confirmed cyclonic circulation, usually small in area, for which warnings are being issued, and whose surface wind speeds do not exceed 33 kts. The numbering of cyclones is not related to the numbering of tropical depressions.

The typhoons were KAREN, MARY, OLIVE, POLLY, SHIRLEY, TRIX, VIRGINIA, WENDY, BESS, CARMEN, DELLA, ELAINE, FAYE, KIT, LOLA, MAMIE, NINA, OPHELIA and PHYLLIS. The tropical storms were LUCILLE, NADINE, ROSE, AGNES, GLORIA, HESTER, IRMA and JUDY.

Warnings were issued on 157 calendar days, and a total of 776 warnings were issued which compares with a total of 583 warnings issued during 1959. After the Season began with Typhoon KAREN, the greatest interval between tropical disturbances was 30 days (between KAREN and T.S. LUCILLE).

Perhaps one of the most interesting features of the 1960 Season was the unusual monthly distribution of typhoons. During August there were 8 typhoons, while in September there were none. Long period climatological records reveal that only during two other years since 1884 were there 8 or more typhoons reported in August (1940, 1942). The same records also show that only in two other years were there no typhoons reported in September (1885, 1904).

The tracks of all typhoons and those of Tropical Storms LUCILLE and NADINE are contained in this chapter. The two tropical storms are included because of reference to them in the press as typhoons. Typhoon tracks for months having one or more typhoons are also included in this chapter. Individual best tracks of all typhoons will be found in Chapter V.

B. AREAS OF FORMATION AND DEVELOPMENT

During 1960, in the area of responsibility of the Joint

Hurricane Warning Center, Hawaii, there were no tropical disturbances for which names, tropical depression numbers or cyclone numbers were assigned.

The typhoons of 1960 occurring within the FWC/JTWC area of responsibility developed south of 25 N, west of 161 E and north of 6 N. Typhoons KAREN, MARY and ELAINE became typhoons in the South China Sea, however KAREN originated in the Pacific and moved across the southern Philippines before becoming a typhoon. While at tropical storm intensity, Typhoons VIRGINIA, DELLA, OPHELIA and PHYLLIS passed within 500 mi of Guam, and Typhoon MAMIE, the largest of the Season, became a typhoon within 250 mi of Guam.

The majority of typhoons were initially detected by surface analyses, and before reaching typhoon strength a period of intensification took place which lasted from one to seven days. It is generally accepted that an initially developed cyclonic circulation must exist under an area of substantial divergence aloft before the circulation can intensify to typhoon strength. During 1960 this statement was substantiated except for the formation of Typhoon WENDY, which appeared to have formed and reached typhoon intensity during a period when its surface position was near an upper level cyclone.

C. SIZE AND INTENSITY

The typhoons of 1960 were definitely less intense than those of 1959. The Table, "1960 Typhoon Data Summary" is provided in this chapter for comparison of typhoons. Data contained in the Table and other information clearly show that the typhoons of 1960 were of weak to moderate intensity. Certainly there were no typhoons during 1960 which compared in intensity to Typhoons JOAN and VERA of 1959. Typhoon MAMIE was the largest of the 1960 Season with the radius of 50 kt surface winds extending 350 mi. Typhoons DELLA, NINA and OPHELIA all had a radius of 50 kt surface winds of 250 mi. Typhoon KAREN, the smallest, had a radius of 50 kt surface winds of only 30 mi. The lowest central surface pressure reported by reconnaissance was 918 mb, reported on both Typhoons TRIX and DELLA. This contrasts with the 1959 season when 6 typhoons had central surface pressures of less than 915 mb, and Typhoons JOAN and VERA had central pressures of 891 and 896 mb, respectively.

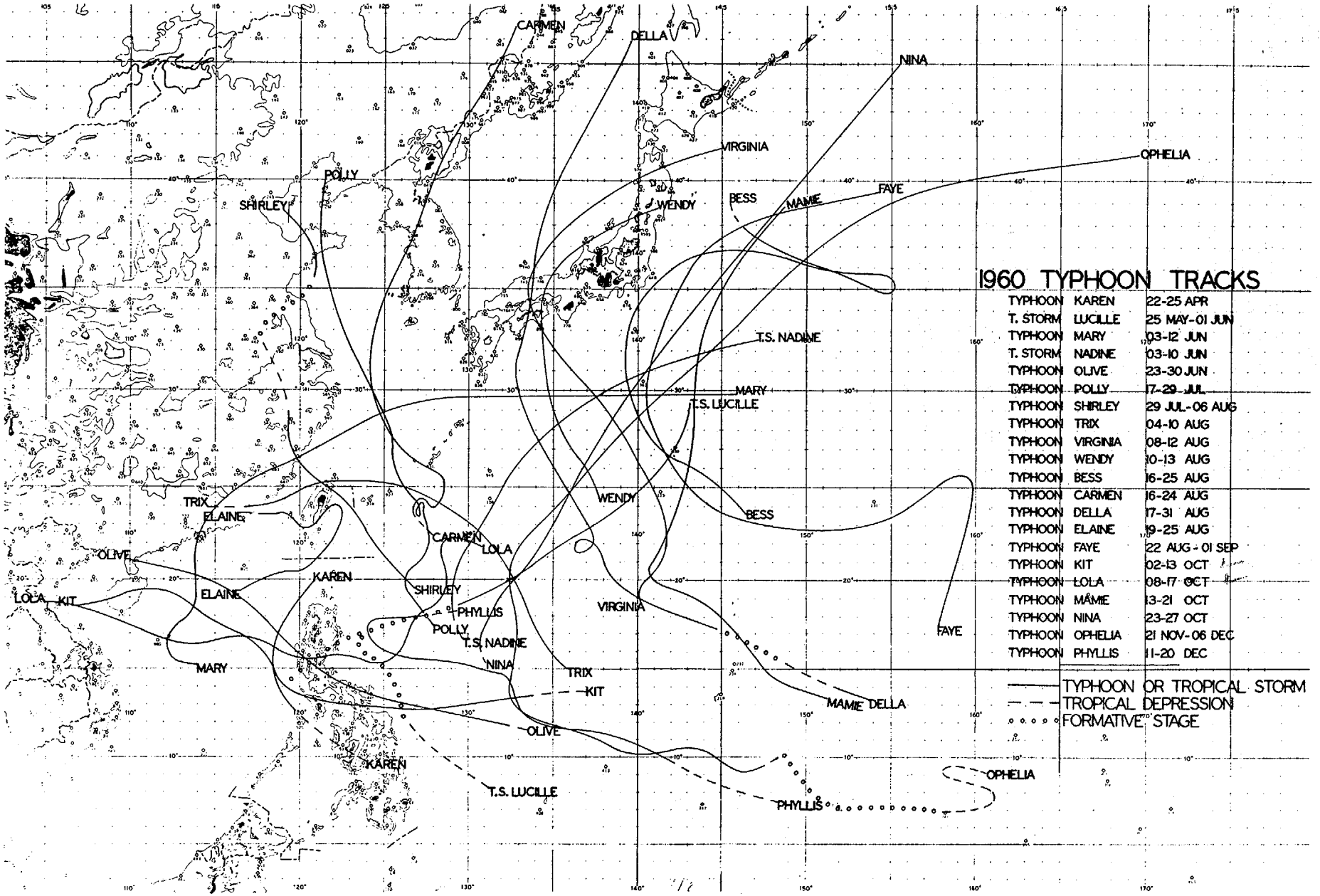
When the western Pacific high at the 200-300 mb level is primarily one large cell, it appears that typhoons are

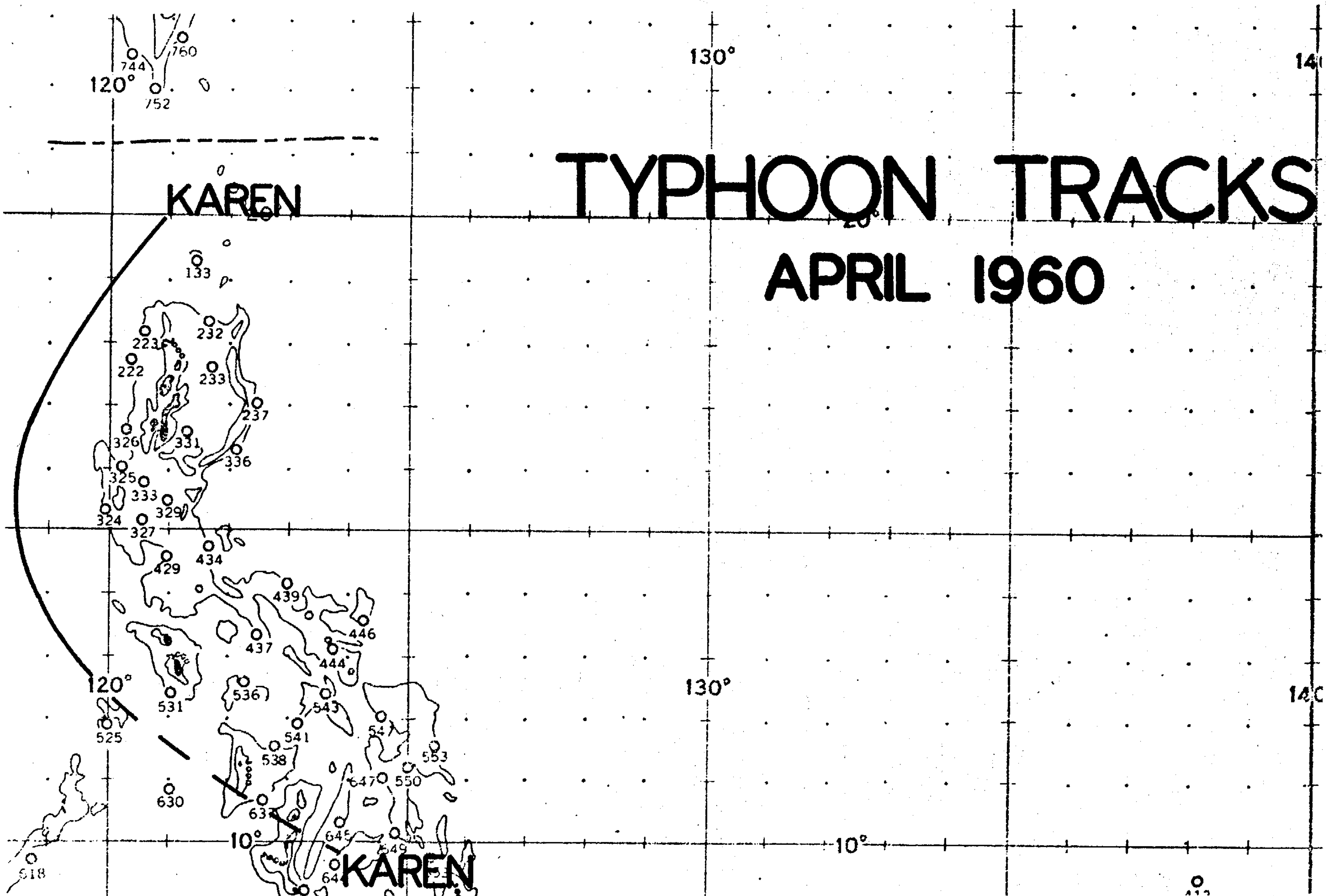
more intense and that there is a greater frequency of large typhoons. The reverse appears to be true when the western Pacific high consists of several small cells at the 200-300 mb levels, i.e., the typhoons are of weak or moderate intensity, and few large typhoons occur. The ideas expressed in the foregoing statements are considered worthy of further investigation and research.

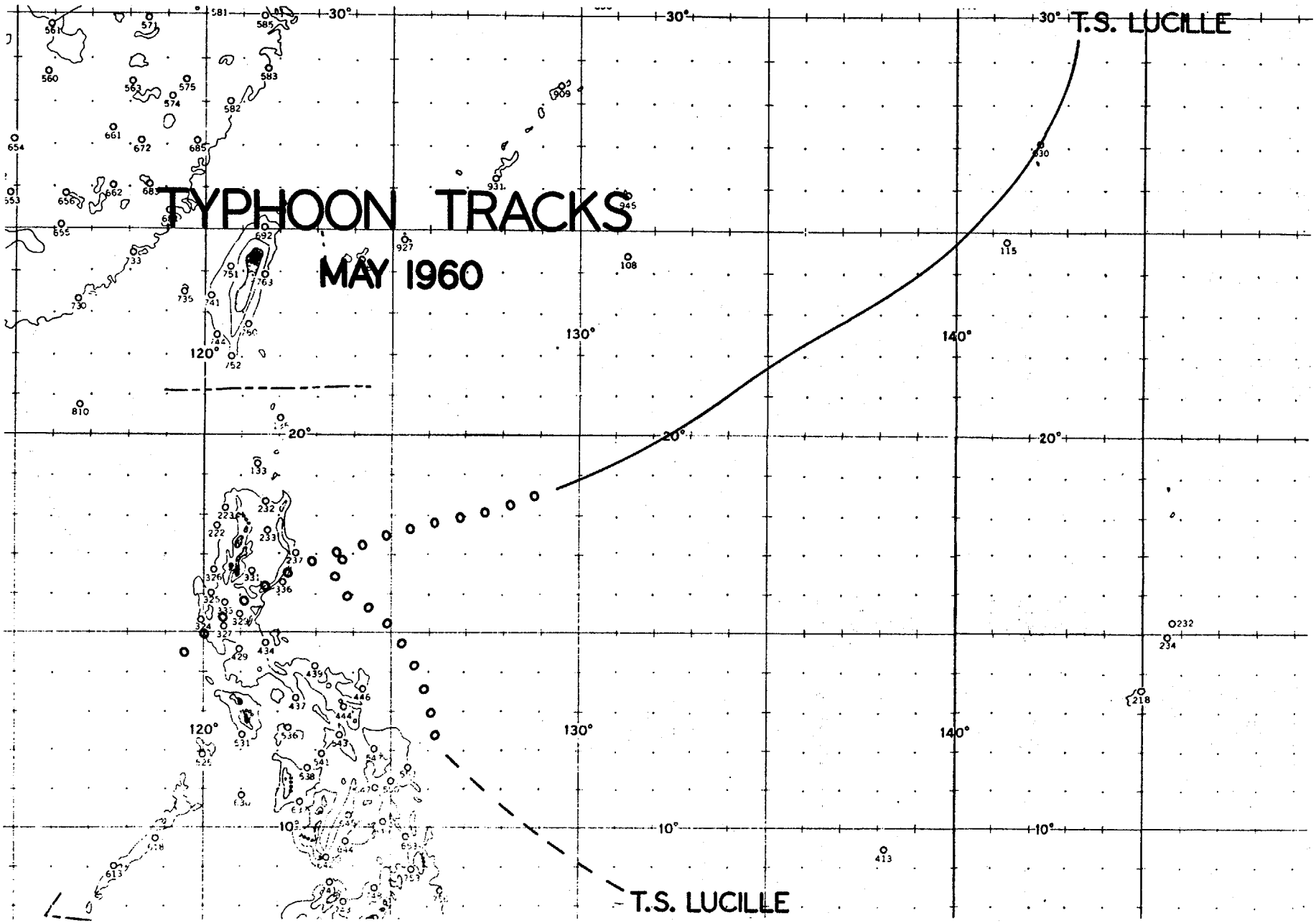
D. MOVEMENT

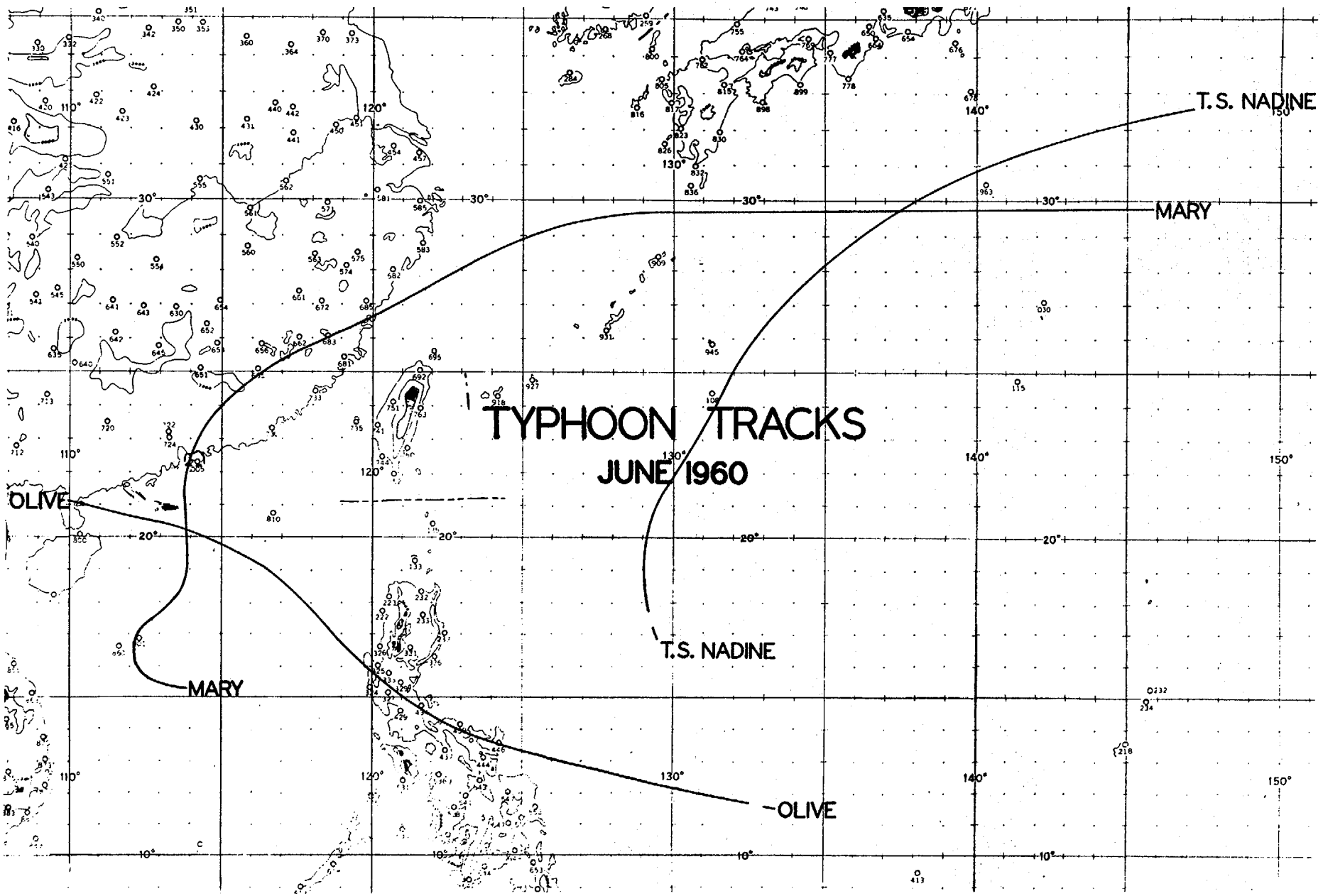
The 1960 Typhoon Season was one of unusual tracks. From a perusal of the chart showing all tracks of 1960, it is easy to understand why the chart is called a "plate of worms". Typhoons BESS, DELLA and POLLY looped, and the tracks of BESS, ELAINE, and LOLA were such as to give ulcers to any Typhoon Duty Officer. Although unusual, the track of ELAINE was not unique, and was found to be quite similar to that of a typhoon of July 1924 (see chart this chapter). Few typhoons approach Luzon in the Philippines from the NE as LOLA did. Examination of the track chart reveals that typhoons of 1960 initially moved along a track between W and N with the exceptions of ELAINE and FAYE.

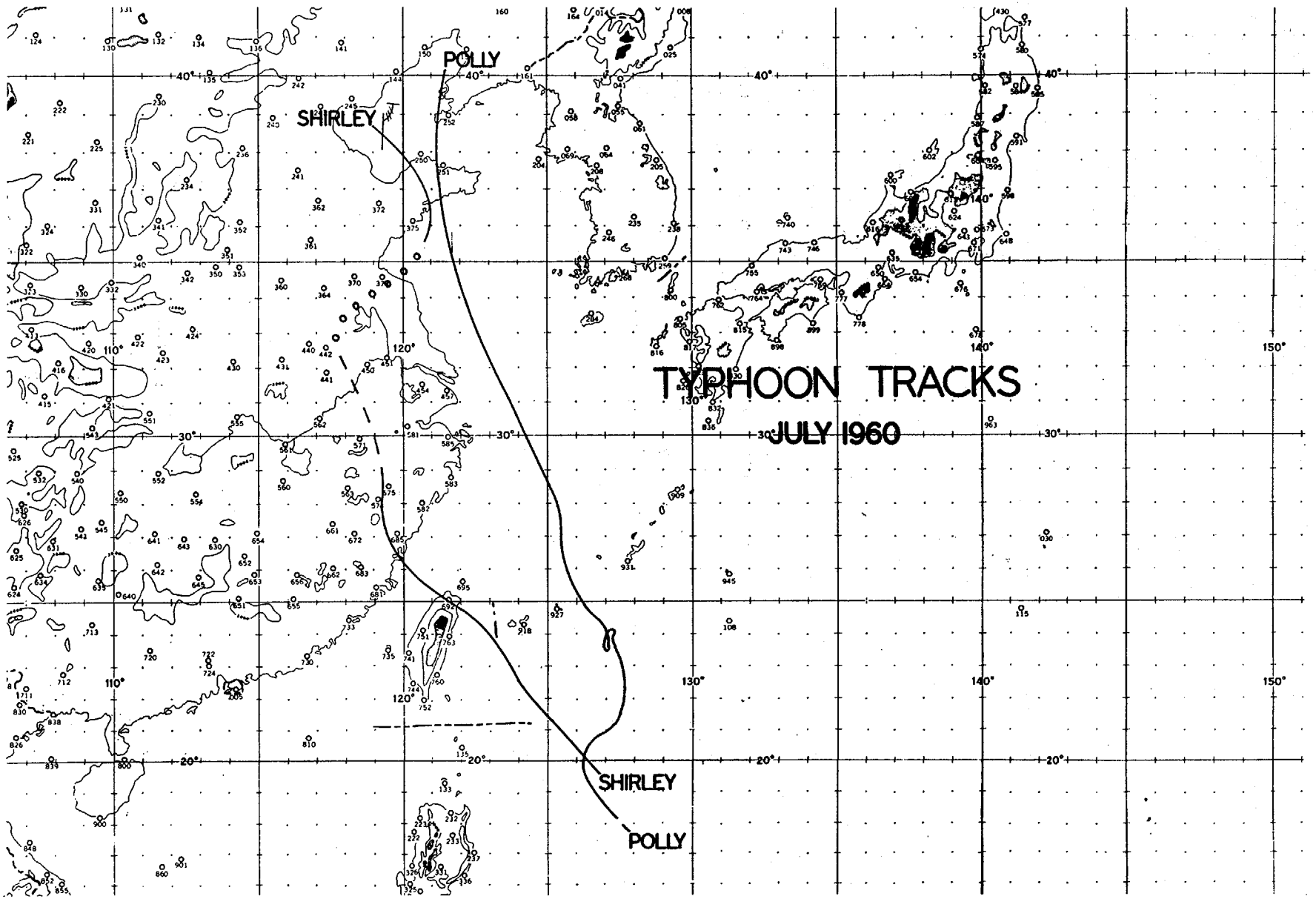
The speed of movement of typhoons varied considerably from typhoon to typhoon, as did the speed of movement within the life cycle of individual typhoons. For example: POLLY moved at an average speed of 6 kts while NINA moved at an average speed of 19 kts; POLLY moved at a speed of only 2 to 3 kts for 4 days before accelerating to 17 kts north of 30 N; and, during the early stages of development, OPHELIA, moved at less than 10 kts, but as she passed to the east of Japan, she moved at an average speed of 53 kts for a 24 hour period.

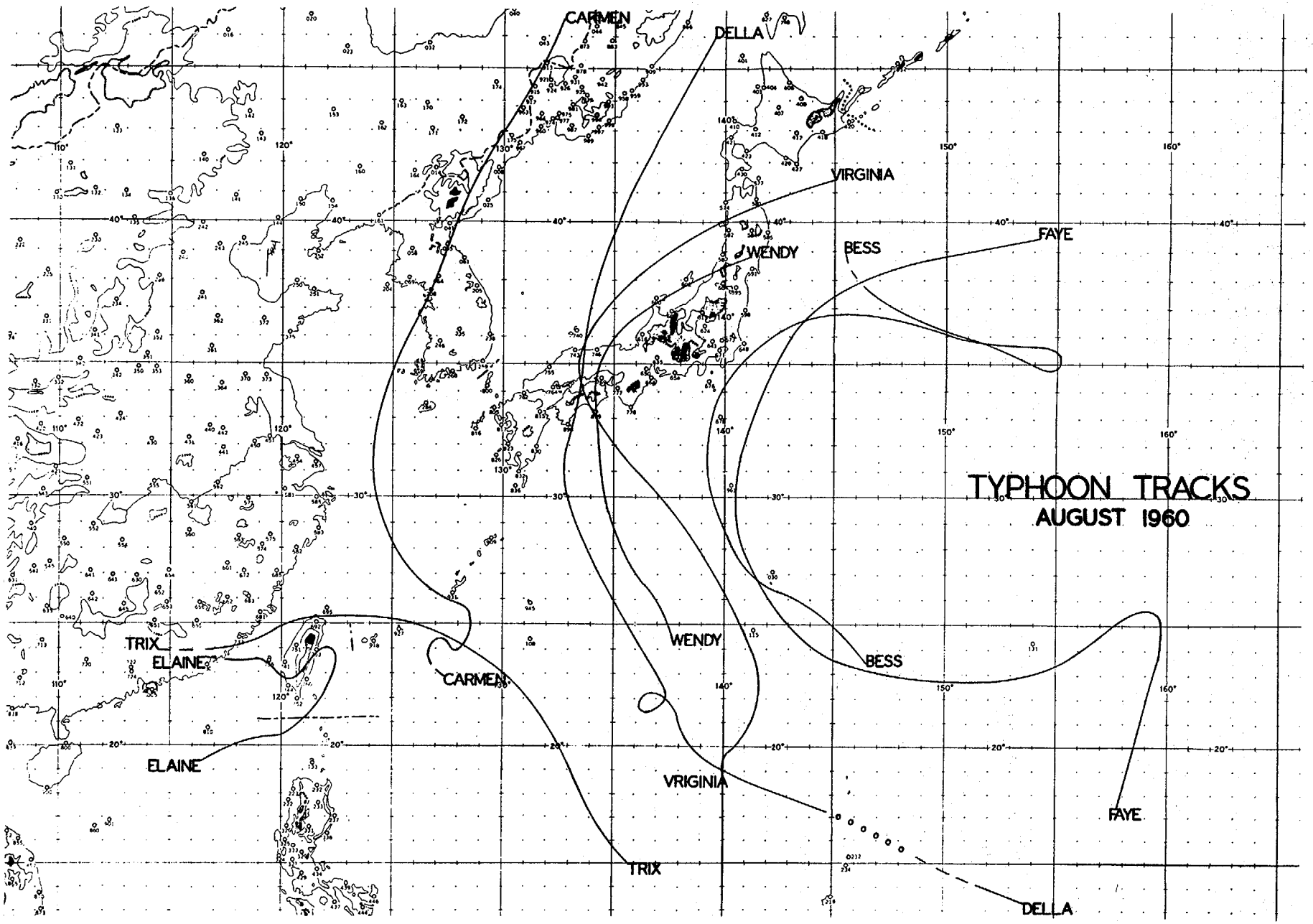

1960 TYPHOON TRACKS
TYPHOON KAREN 22-25 APR
T. STORM LUCILLE 25 MAY-01 JUN
TYPHOON MARY 03-12 JUN
T. STORM NADINE 03-10 JUN
TYPHOON OLIVE 23-30 JUN
TYPHOON POLLY 17-29 JUL
TYPHOON SHIRLEY 29 JUL-06 AUG
TYPHOON TRIX 04-10 AUG
TYPHOON VIRGINIA 08-12 AUG
TYPHOON WENDY 10-13 AUG
TYPHOON BESS 16-25 AUG
TYPHOON CARMEN 16-24 AUG
TYPHOON DELLA 17-31 AUG
TYPHOON ELAINE 19-25 AUG
TYPHOON FAYE 22 AUG - 01 SEP
TYPHOON KIT 02-13 OCT
TYPHOON LOLA 08-17 OCT
TYPHOON MAMIE 13-21 OCT
TYPHOON NINA 23-27 OCT
TYPHOON OPHELIA 21 NOV-06 DEC
TYPHOON PHYLLIS 11-20 DEC
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
CARMEN
DELLA
NINA
VIRGINIA
OPHELIA
POLLY
SHIRLEY
WENDY
BESS
MAMIE
FAYE
T.S. NADINE
MARY
T.S. LUCILLE
TRIX
ELAINE
OLIVE
KAREN
LOLA
KIT
PHYLLIS

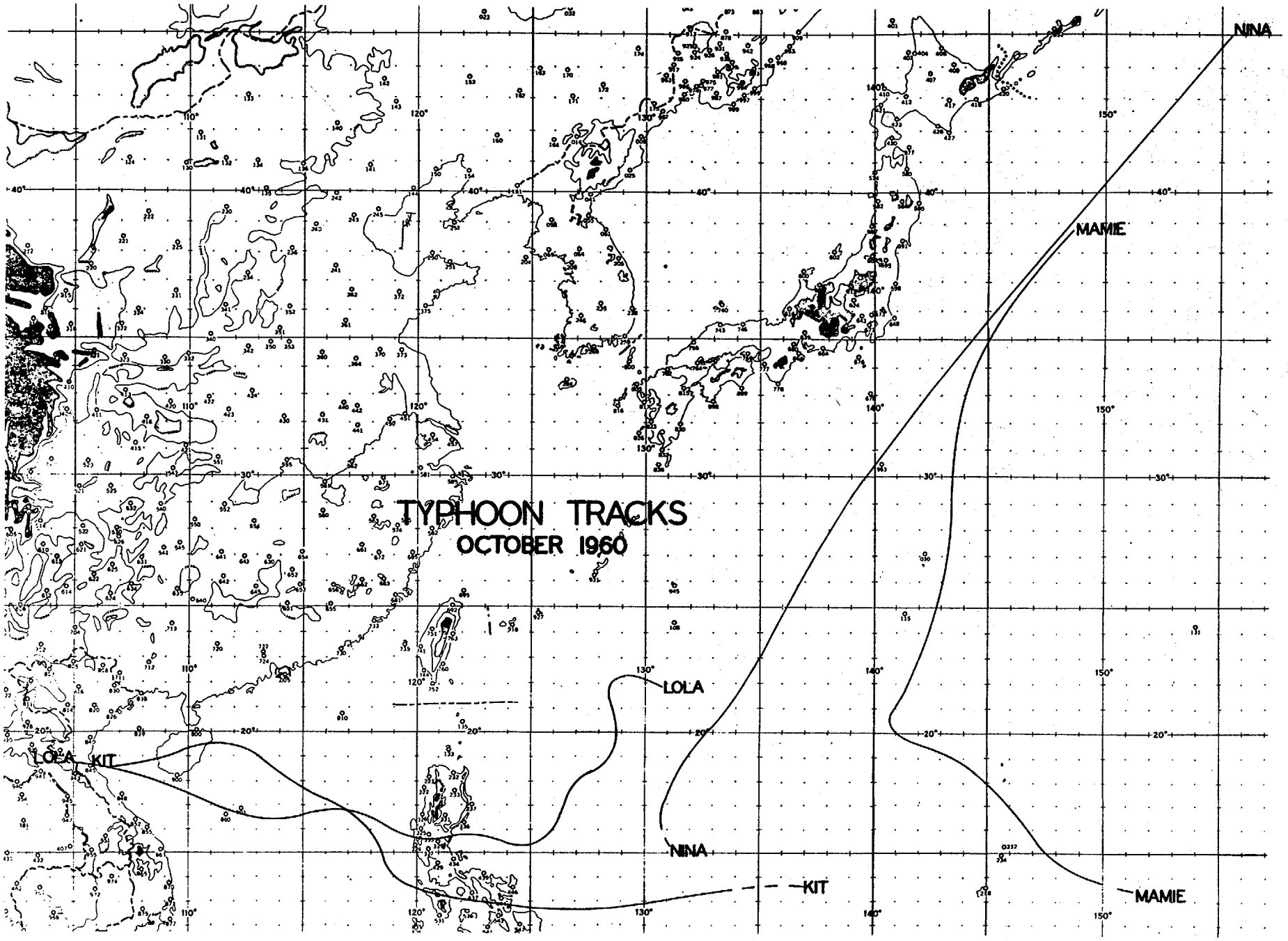

TYPHOON TRACKS
APRIL 1960
KAREN
KAREN
120°
130°
20°
10°

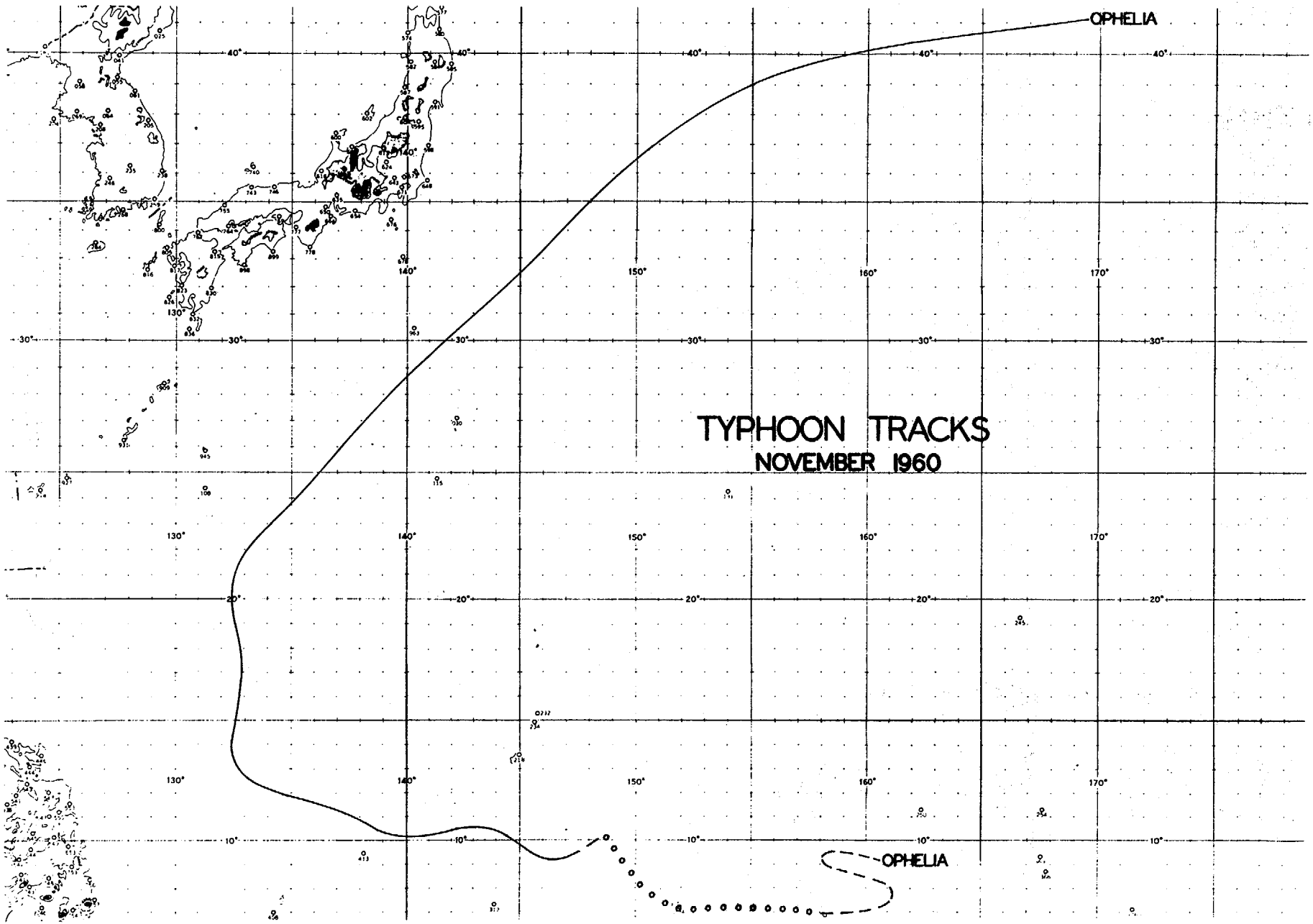

TYPHOON TRACKS
MAY 1960
T.S. LUCILLE
T.S. LUCILLE
30°
20°
10°
120°
130°
140°

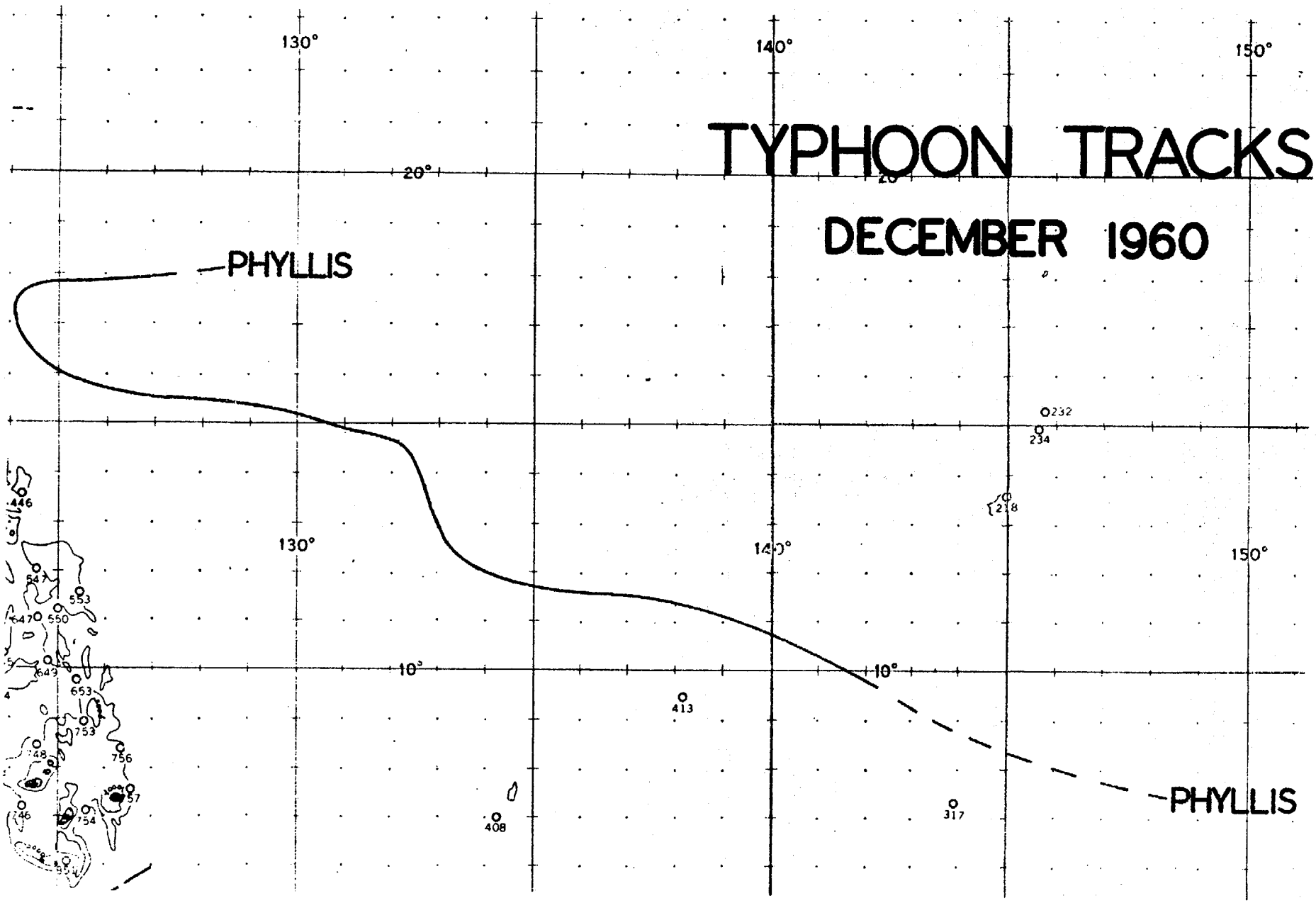

TYPHOON TRACKS
JUNE 1960
T.S. NADINE
MARY
OLIVE
T.S. NADINE
MARY
OLIVE


POLLY
SHIRLEY
TYPHOON TRACKS
JULY 1960
SHIRLEY
POLLY


CARMEN
DELLA
VIRGINIA
WENDY
BESS
FAYE
TRIX
ELAINE
CARMEN
WENDY
BESS
ELAINE
VRIGINIA
FAYE
TRIX
DELLA
TYPHOON TRACKS
AUGUST 1960


TYPHOON TRACKS
OCTOBER 1960
NINA
MAMIE
LOLA
KIT
LOLA
KIT
NINA
MAMIE


OPHELIA
TYPHOON TRACKS
NOVEMBER 1960
OPHELIA


TYPHOON TRACKS
DECEMBER 1960
PHYLLIS
PHYLLIS
130°
140°
150°
20°
10°
232
234
218
413
317
408
446
547
553
647
550
649
653
753
748
756
746
754
757

TROPICAL CYCLONES OF 1960

	CYCLONE	*PERIOD
01.	Investigation	03 Jan - 06 Jan
02.	Tropical Depression IVY (T.D. 1)	30 Jan - 01 Feb
03.	Tropical Depression JEAN (T.D. 2)	06 Mar - 08 Mar
04.	Investigation	30 Mar - 01 Apr
05.	Investigation	12 Apr - 18 Apr
06.	Typhoon KAREN	22 Apr - 25 Apr
07.	Tropical Storm LUCILLE	25 May - 01 Jun
08.	Typhoon MARY	03 Jun - 12 Jun
09.	Tropical Storm NADINE	03 Jun - 10 Jun
10.	Investigation	17 Jun - 18 Jun
11.	Investigation	20 Jun - 21 Jun
12.	Typhoon OLIVE	23 Jun - 30 Jun
13.	Investigation	28 Jun - 29 Jun
14.	Investigation	30 Jun - 01 Jul
15.	Investigation	01 Jul - 02 Jul
16.	Investigation	07 Jul - 08 Jul
17.	Investigation	12 Jul - 13 Jul
18.	Investigation	14 Jul - 16 Jul
19.	Typhoon POLLY	17 Jul - 29 Jul
20.	Investigation	23 Jul - 24 Jul
21.	Tropical Storm ROSE	25 Jul - 28 Jul
22.	Typhoon SHIRLEY	28 Jul - 06 Aug
23.	Investigation	31 Jul - 01 Aug
24.	Typhoon TRIX	01 Aug - 10 Aug
25.	Investigation	04 Aug - 05 Aug
26.	Investigation	06 Aug - 08 Aug
27.	Typhoon VIRGINIA	07 Aug - 12 Aug
28.	Typhoon WENDY	10 Aug - 13 Aug
29.	Tropical Storm AGNES	11 Aug - 16 Aug
30.	Typhoon BESS	13 Aug - 25 Aug
31.	Typhoon CARMEN	15 Aug - 24 Aug
32.	Typhoon DELLA	16 Aug - 31 Aug
33.	Typhoon ELAINE	19 Aug - 25 Aug
34.	Typhoon FAYE	22 Aug - 01 Sep
35.	Tropical Storm GLORIA	30 Aug - 04 Sep
36.	Tropical Storm HESTER	04 Sep - 10 Sep
37.	Investigation	08 Sep - 09 Sep
38.	Tropical Storm IRMA	10 Sep - 19 Sep
39.	Investigation	11 Sep - 13 Sep
40.	Investigation	13 Sep - 14 Sep

TROPICAL CYCLONES OF 1960 - (CONT'D)

	CYCLONE	*PERIOD
41.	Investigation	17 Sep - 18 Sep
42.	Investigation	20 Sep - 22 Sep
43.	Investigation	22 Sep - 23 Sep
44.	Tropical Storm JUDY	24 Sep - 29 Sep
45.	Investigation	29 Sep - 30 Sep
46.	Tropical Depression 19	30 Sep - 01 Oct
47.	Typhoon KIT	01 Oct - 13 Oct
48.	Typhoon LOLA	08 Oct - 17 Oct
49.	Investigation	11 Oct - 13 Oct
50.	Typhoon MAMIE	12 Oct - 21 Oct
51.	Typhoon NINA	16 Oct - 27 Oct
52.	Investigation	31 Oct - 04 Nov
53.	Typhoon OPHELIA	21 Nov - 06 Dec
54.	Investigation	30 Nov - 02 Dec
55.	Investigation	07 Dec - 09 Dec
56.	Typhoon PHYLLIS	09 Dec - 20 Dec

* The period shown covers the period from the date the cyclone was first assigned a cyclone number, until the final warning was issued, or if no warnings were issued, the date the cyclone dissipated.

1960 TYPHOON DATA SUMMARY

TYPHOON	FROM RECON MAX OBSVD SFC WND	FROM WARNINGS MAX SFC WND	FROM WARNINGS MAX RADIUS 100KT WND	FROM WARNINGS MAX RADIUS 50KT WND	FROM RECON MAX TEMP (C)	FROM RECON MIN 700MB HGT	FROM RECON MIN SLP (MBS)
KAREN	75	75	--	30	18	9940	988
*LUCILLE	---	45	--	---	--	----	---
MARY	65	75	--	75	16	9590	988
*NADINE	75	60	--	50	21	----	967
OLIVE	100	125	30	75	19	8800	950
POLLY	125	115	--	75	18	8630	950
SHIRLEY	130	125	30	100	21	7510	---
TRIX	130	135	50	100	24	8130	918
VIRGINIA	110	90	--	125	16	9590	971
WENDY	75	65	--	50	16	9960	986
BESS	60	70	--	100	18	9500	942
CARMEN	75	75	--	150	18	9420	970
DELLA	100	105	--	250	18	9170	918
ELAINE	80	80	--	75	17	9610	976
FAYE	135	135	40	125	18	8570	940
KIT	100	90	--	100	18	9200	966
LOLA	80	80	--	50	22	9600	978
MAMIE	150	115	40	350	23	8420	940
NINA	120	110	40	250	19	8810	954
OPHELIA	175	140	40	250	28	7960	928
PHYLLIS	110	115	30	150	21	9110	962

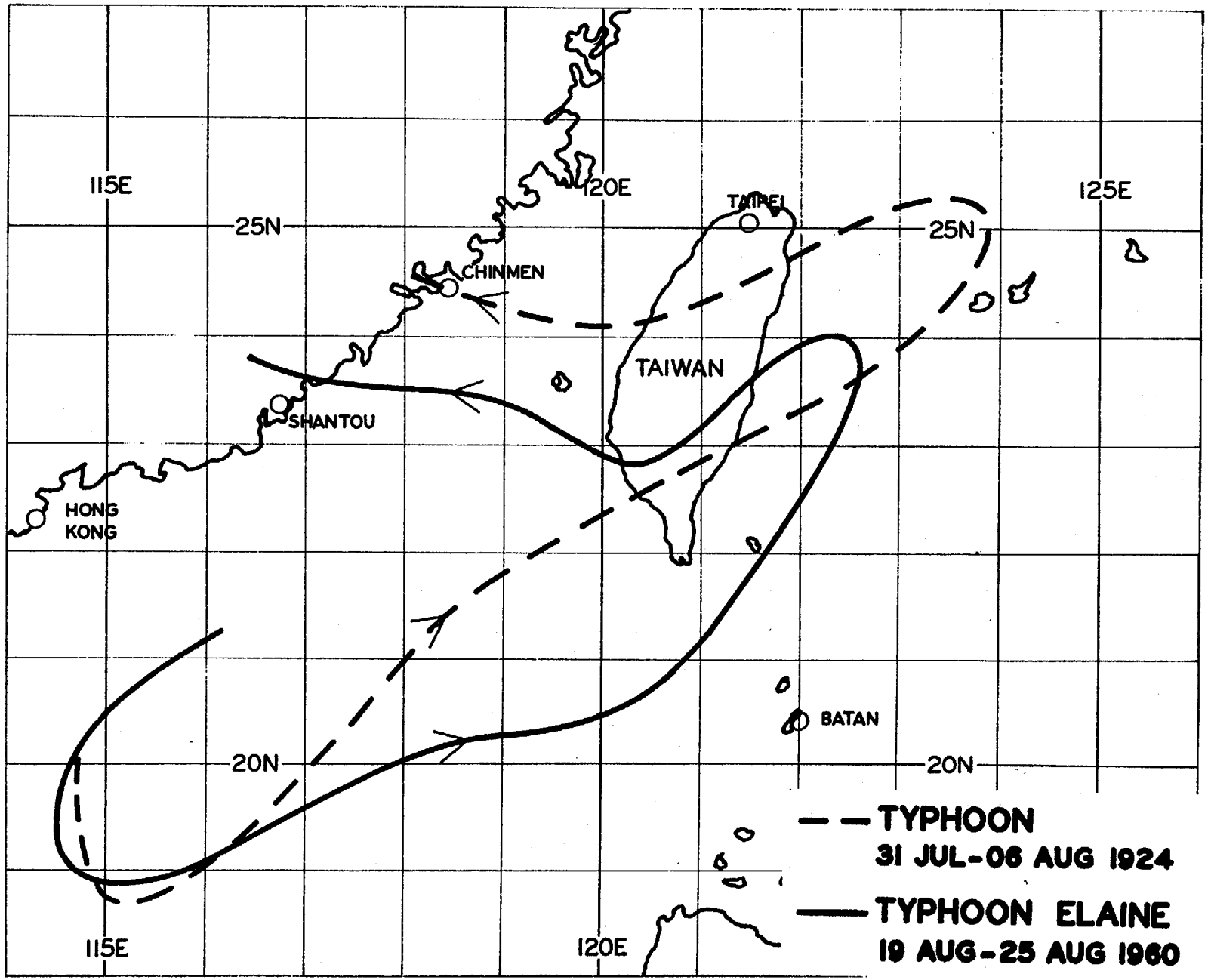
*TROPICAL STORM

1960 TYPHOON FORECAST ERRORS
(IN MI)

TYPHOON	24 HR FORECASTS NO. OF CASES	24 HR FORECASTS MEAN ERROR	48 HR FORECASTS NO. OF CASES	48 HR FORECASTS MEAN ERROR
KAREN	5	114	1	284
*LUCILLE	6	206	2	594
MARY	31	148	27	349
*NADINE	16	104	12	196
OLIVE	20	127	16	218
POLLY	37	85	33	184
SHIRLEY	14	103	10	185
TRIX	21	173	17	436
VIRGINIA	7	308	3	500
WENDY	4	240	0	- -
BESS	14	205	10	480
CARMEN	21	154	17	265
DELLA	37	173	29	361
ELAINE	16	148	12	323
FAYE	30	246	26	505
KIT	32	102	28	174
LOLA	32	148	28	284
MAMIE	19	165	15	327
NINA	9	210	5	247
OPHELIA	30	147	26	323
PHYLLIS	28	157	24	346

*TROPICAL STORM

AVERAGE ERROR-24 HR FORECASTS (429 CASES). 154
AVERAGE ERROR-48 HR FORECASTS (341 CASES). 311


115E
120E
125E
25N
20N
TAIPEI
CHINMEN
SHANTOU
TAIWAN
HONG
KONG
BATAN
TYPHOON
31 JUL-06 AUG 1924
TYPHOON ELAINE
19 AUG-25 AUG 1960